United States
Department of
Agriculture

Forest Service

Pacific Northwest
Research Station

Research Paper
PNW-RP-394

Invertebrates of Meadow Creek, Union County, Oregon, and Their Use as Food by Trout

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Abstract

McLemore, Carl E.; Meehan, William R. 1988. Invertebrates of Meadow Creek, Union County, Oregon, and their use as food by trout. Res. Pap. PNW-RP-394. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 13 p.

From 1976 to 1980, invertebrates were collected three times each year from several reaches of Meadow Creek in eastern Oregon. Five sampling methods were used: benthos, drift, sticky traps, water traps, and fish stomachs. A total of 372 taxa were identified, of which 239 were used as food by rainbow trout (steelhead; *Salmo gairdneri* Richardson). Of the taxa found in trout stomachs, 71 (29.5 percent) were terrestrial.

Keywords: Invertebrates, aquatic life, salmonids.

Contents

Introduction

From 1976 to 1980, we sampled stream invertebrates of Meadow Creek, Union County, Oregon. The objective of this paper is to list the taxa collected during spring, summer, and fall by five sampling methods. This information was obtained as part of a broader study of the effects of livestock grazing on fish habitat, the results of which will be reported later.

Study Area

The stream selected for study was Meadow Creek, a fourth-order tributary of the Grande Ronde River in the Blue Mountains of northeastern Oregon, about 48 km southwest of LaGrande (fig. 1). The study sections of Meadow Creek are located on the Starkey Experimental Forest and Range. The stream maintains populations of resident (rainbow) and anadromous (steelhead) trout (*Salmo gairdneri* Richardson). Minimum streamflow, maintained mainly by springs, fluctuates with summer storms (Bryant and Skovlin 1982). Stream temperatures range from 0 °C in winter, when surface water is frozen and deep pools remain unfrozen, to about 26.7 °C in midsummer. The stream is about one-fourth shaded (Bryant and Skovlin 1982) by ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.), grand fir (*Abies grandis* (Dougl. ex D. Don) Lindl.), Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), and lodgepole pine (*Pinus contorta* Dougl. ex Loud.), and to a lesser extent, by mountain alder (*Alnus tenuifolia* Nutt.) and willow (*Salix* spp.).

Ten study sections were established on the stream (fig. 1). The physical features of all sections were similar. The streambed at sampling sites varied from sand (1.5 mm in diameter) to large cobbles (127.0 to 254.0 mm in diameter).

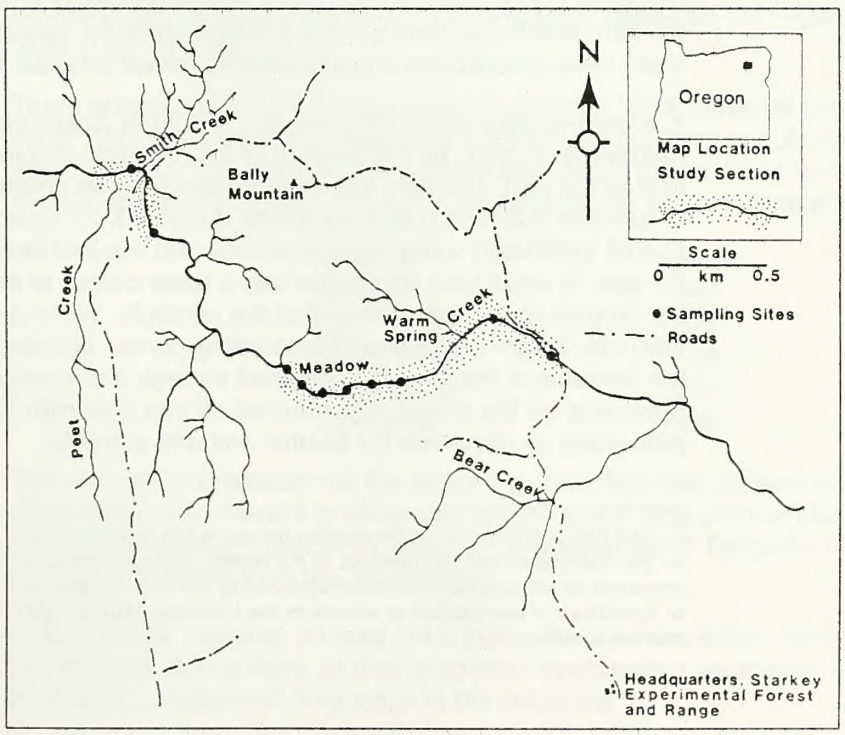

Figure 1—Locations of sampling sites.

Materials and Methods

Sample Types

Benthos.—Benthic samples were collected with a modified Hess sampler[1] covering a surface area of 0.09 m^2. Two samples were collected from each study section and preserved in formal alcohol (half 70 percent ethanol and half 10 percent formalin). In the laboratory, invertebrate organisms were sorted from the samples, counted, and identified to the lowest feasible taxon (generally to family, and to genus or species where practicable); the entire sample was then freeze dried and weighed on an analytical balance to the nearest one-tenth milligram.

Drift.—Aquatic drift was sampled in each study section with a 280-micrometer-mesh Nitex drift net, 76 cm long. Drift net openings were 0.46 by 0.31 m. During each sampling period, drift was sampled for 24 h. Samples were processed in the field and in the laboratory as described above.

Sticky traps and water traps.—Terrestrial insects and adult aquatic insects that drop into the stream and become part of the drift and potential fish food supply were collected during each sampling period by sticky traps and water traps. A pair (one of each type) was placed at each of two sites within each study section.

A sticky trap consisted of a 0.31-m^2 piece of 6.35-mm plywood (painted white) covered with a piece of 6-mil clear polyethylene film. This 0.31-m^2 surface was then sprayed with "Tree Tanglefoot," a sticky substance used to trap crawling insects on trees. The board was then taped to a 0.36-m by 0.36-m by 5.1-cm-thick styrofoam float. When the trap was removed from the stream at the end of a sampling period, the plastic film was cut off at the edges of the board so that a 0.31-m^2 collection surface was retained. Butcher paper was placed over the sticky side to prevent crushing or mold damage to the specimens, and the film and butcher paper "sandwich" was transported to the laboratory. In the laboratory, the butcher paper was removed from the film, which was then cut into 2.54-cm strips for viewing under a microscope. Insects were counted and identified to the lowest possible taxon, usually family.

A water trap was made from a 0.33- by 0.28-m plastic dishpan, 0.13 m deep, surrounded by a 0.61- by 0.61-m ring of 5.1-cm-thick styrofoam that supported and floated the pan. The pan was filled to about half its depth with water, to which 28.4 g of formalin and 28.4 g of a surfactant (Ortho RX-77 Spreader) were added. The surfactant eliminated water surface tension and allowed insects to settle to the bottom of the pan. A small hole was bored into a lower corner of the pan and fitted with a rubber stopper to facilitate removal of the contents. When a water trap was removed from the stream at the end of a sampling period, the corner plug was removed and the contents of the pan were strained through a 0.5-mm-mesh screen. The material remaining on the screen was washed off into a jar with formal alcohol and then processed as described for benthic and drift samples.

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[1] The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others that may be suitable.

Fish stomachs.—During each sampling trip, 10 steelhead (rainbow) trout were captured by electrofishing in each study section. Fish were anesthetized with Tricaine Methanesulfonate, MS-222, and then were measured and weighed. Stomachs were flushed by use of the technique described by Meehan and Miller (1978). Samples were treated and analyzed in the field and laboratory in a manner similar to that for benthic, drift, and water trap samples. Fish from 50- to 150-mm fork length were used when possible because complete flushing of larger fish was difficult and error was more likely in feeding habits for different size classes of fish.

Sampling Schedule

Samples were collected three times each year (1976-80) in spring (mid-May to late May), summer (late July to early August), and fall (late October to early November). Sampling periods varied from 3 to 7 days; 5 days was the usual duration. Sticky traps and water traps were set out in each study section at the beginning of a sampling period and removed at the end of the period. As each study section was sampled, a drift net was set out for 24 h, during which time the benthic and fish stomach samples for that section were collected.

Identification of Organisms

Several publications were used in identifying the organisms collected. Invertebrates, other than insects, were identified through descriptions in Ward and Whipple (1959), Miller (1960), and Pennak (1978). Aquatic insects were identified by means of taxonomic keys in Hatch (1953, 1957, 1961, 1965, 1971), Usinger (1956), Jensen (1966), Cole (1969), Anderson (1976), Edmunds and others (1976), Baumann and others (1977), Wiggins (1977), and Merritt and Cummins (1978). Terrestrial insects were identified primarily from Borror and others (1976) and Richards and Davies (1977).

Results and Discussion

Invertebrates were listed as aquatic or terrestrial, based on the organism's habitat for most of its life (table 1).

Three taxonomic groups (10 individual organisms) were collected only on sticky traps: Pseudoscorpionida (scorpionlike spider), Cyclorrhapha (suborder of Diptera), and Cydnidae (gall wasps). The relative abundance of individual taxa collected on sticky traps was less than one-third that collected by the other trapping methods:

Method	Taxon
Benthos	210
Drift	248
Sticky traps	69
Water traps	209
Stomachs	239

The terrestrial contribution to the sticky trap sampling was 33 taxa or 47.8 percent. Some problems inherent in sticky trap sampling are: less precise identification of taxa, decomposition, predation, variation in application of Tanglefoot, and the escape of large organisms from the Tanglefoot.

In the benthic samples, 30 taxa (14.5 percent) were terrestrial. Terrestrial taxa drop into streams during flight, or they drop from overhanging vegetation and are carried in stream currents until they lodge in the substrate.

In drift samples, 66 taxa (25.6 percent) were terrestrial. This percentage compares closely with the 29.5 percent found in stomach samples.

Of the taxa collected in water traps, 88 (41.6 percent) were terrestrial. Water trap and sticky trap samples were expected to contain a higher percentage of terrestrial taxa than were samples collected by the other methods, and the percentage of composition of invertebrates collected by these two types of trap is similar.

The most abundant taxon collected during the study was the family Chironomidae (32,484 individuals). Chironomids were found in 713 of the 930 fish stomachs sampled. The second most numerous taxon was the genus *Lepidostoma* (31,765 individuals); 484 stomachs (52 percent) contained this genus.

Examination of stomach contents presents many problems, not the least of which is the identification of the prey that have been eaten. *Baetis hageni* (*parvus*) Eaton is an excellent example. The data show that 3,306 *B. hageni* were collected during the study, but this species was found only in benthic and drift samples. The only baetids found in stomach samples that could be identified to species were *B. bicaudatus* and *B. tricaudatus*. If *B. hageni* were present in stomach samples, they were identified only to the genus, family, or order level. Even a skilled entomologist is at a disadvantage if only mangled pieces of organisms remain to study without well-preserved general collections from the habitat where the fish were feeding.[2]

Stomach samples of juvenile salmonids show that the fish consume a wide variety of organisms (Siebert and Kask 1978). We collected 372 taxa by the several sampling methods; trout stomachs contained 239 (64.2 percent) of these taxa. The availability of a given prey is not determined simply by its abundance, but also by the predator's feeding strategy and the behavior and morphology of the prey (Chess 1978).

Terrestrial, as well as aquatic, ecosystems are sources of invertebrate food for fish. Streambanks and the entire riparian zone are particularly important. The terrestrial component of the diet of trout in our study was 71 taxa (29.5 percent), which demonstrates the value of riparian habitat.

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[2] Personal communication, Kenneth W. Cummins, Appalachian Environmental Laboratory for Environmental and Estuarine Studies, University of Maryland, Frostburg State College Campus, Frostburg, MD 21532.

Table 1—Invertebrates collected from Meadow Creek, Union County, Oregon, 1976-80

Taxon	Number	Sample type[1]	Habitat type[2]	Season[3]	Life stage[4]
Turbellaria					
Tricladida					
Planariidae	34	1	A	1,3	A
Nematoda	454	1,2,4,5	A	1,2,3	LA
Oligochaeta	1,992	1,2,4,5	A	1,2,3	LA
Hirudinea	12	1,5	A	1,2,3	A
Gastropoda	10	1,5	A	1,3	A
Basommatophora					
Physidae					
Physa spp.	231	1,2,4,5	A	1,2,3	LA
Planorbidae	1	1	A	3	A
Ancylidae	43	1	A	1,2,3	A
Lancidae					
Lanx spp.	6	1	A	3	A
Pelecypoda	2	1,5	A	3	A
Sphaeriidae	30	1	A	1,2,3	A
Unionidae	3	1	A	2,3	A
Crustacea					
Decapoda					
Astacidae	8	1,5	A	1,2,3	A
Pacifastacus (Astacus) sp.	1	1	A	3	A
P. klamathensis (Stimpson)	1	1	A	3	A
P. trowbridgi (Stimpson)	28	1,2	A	1,2,3	A
Isopoda	1	2	T	1	A
Ostracoda	15	1,2,4	T	2,3	A
Copepoda	4	1,2,5	A	2,3	A
Arachnida					
Araneae	2,440	1, 2, 3, 4, 5	T	1, 2, 3	A
Acarina	1,235	1, 2, 4, 5	T	1, 2, 3	A
Pseudoscorpionida	2	3	T	1	A
Opiliones	9	3, 4	T	1, 2, 3	A
Insecta	4	2, 4, 5	U	1, 2, 3	LPA
Dermaptera	2	4, 5	T	3	A
Forficulidae	2	4	T	2, 3	A
Collembola	70	2, 3, 4, 5	A	1, 2, 3	A
Entomobryidae	62	1, 2, 5	A	1, 2, 3	LA
Sminthuridae	8	2, 4	A	1, 2, 3	A
Poduridae	390	1, 2, 3, 4, 5	A	1, 2, 3	A
Isotomidae	181	1, 2, 3, 4, 5	A	1, 2, 3	A
Ephemeroptera	1,090	2, 3, 4, 5	A	1, 2, 3	LA
Siphlonuridae	1	4	A	3	A
Siphlonurus spp.	9	2	A	2, 3	L
Ameletus spp.	600	1, 2, 4, 5	A	1, 2, 3	LA
Tricorythidae					
Tricorythodes spp.	1,084	1, 2, 4, 5	A	1, 2, 3	LA
Baetidae	787	1, 2, 4, 5	A	1, 2, 3	LA
Baetis spp.	1,043	1, 2, 4, 5	A	1, 2, 3	LA
B. bicaudatus Dodds	21	2, 4, 5	A	1, 2, 3	LA
B. hageni (parvus) Eaton	3,306	1, 2	A	1, 2, 3	L
B. tricaudatus Dodds	3,098	1, 2, 4, 5	A	1, 2, 3	L
Centroptilum spp.	2,045	1, 2, 4, 5	A	1, 2, 3	LA
Pseudocloeon sp.	1,559	1, 2, 4, 5	A	1, 2, 3	LA
Heptageniidae	424	1, 2, 3, 4, 5	A	1, 2, 3	LA
Epeorus spp.	378	1, 2, 4, 5	A	1, 2, 3	L
E. longimanus Eaton	1,386	1, 2, 5	A	1, 2, 3	LA
Cinygmula spp.	1,039	1, 2, 4, 5	A	1, 2, 3	L
Cinygma spp.	7	1, 4, 5	A	1, 2, 3	L
Heptagenia sp.	119	5	A	2	L

Table 1—Invertebrates collected from Meadow Creek, Union County, Oregon, 1976-80 (continued)

Taxon	Number	Sample type[1]	Habitat type[2]	Season[3]	Life stage[4]
H. criddlei McDunnough	935	1, 2, 4, 5	A	1, 2, 3	LA
Rhithrogena spp.	8	1, 2	A	3	L
R. hageni Eaton	29	1	A	3	L
R. robusta Dodds	35	1, 2	A	3	L
Leptophlebiidae	7	4	A	1, 2, 3	A
Paraleptophlebia spp.	705	1, 2, 3, 4, 5	A	1, 2, 3	LA
P. bicornuta McDunnough	568	1, 2, 4, 5	A	1, 2, 3	L
P. debilis (Walker)	13	1, 2, 5	A	1, 3	L
P. temporalis McDunnough	3,222	1, 2, 5	A	1, 2, 3	LA
Ephemerellidae	3	4	A	3	A
Ephemerella spp.	1,498	1, 2, 3, 4, 5	A	1, 2, 3	LA
E. aurvillii Bengtsson	58	5	A	1, 2, 3	L
E. doddsi Needham	104	1, 2, 5	A	1, 3	L
E. flavilinea McDunnough	52	1, 2	A	1, 3	L
E. grandis Eaton	54	1, 2, 5	A	1, 3	L
E. infrequens McDunnough	4,961	1, 2, 4, 5	A	1, 2, 3	L
E. spinifera Needham	6	1, 2	A	1, 2	L
E. tibialis McDunnough	283	1, 2, 5	A	1, 2, 3	L
E. (Drunella) sp. Needham, Edmonds	8	1, 2, 5	A	1	L
E. hecuba Eaton	12	1, 5	A	2	L
E. margarita Needham	539	1, 2	A	1, 2, 3	L
E. (Serratella) spp. Edmunds	41	5	A	1, 2, 3	L
E. (Ephemerella) spp. Walsh	20	5	A	1, 2, 3	L
Odonata	19	1, 3	A	1, 2, 3	LA
Gomphidae	63	1, 2	A	1, 2, 3	LA
Aeshnidae	1	5	A	2	L
Orthoptera	26	2, 3, 4, 5	T	1, 2, 3	LA
Gryllacrididae	1	4	T	3	A
Acrididae	12	1, 2, 4, 5	T	1, 2, 3	LA
Plecoptera	252	1, 2, 3, 4, 5	A	1, 2, 3	LA
Pteronarcidae					
Pteronarcella sp.	1	U	A	U	L
Pteronarcys spp.	5	1, 5	A	1, 2, 3	L
P. princeps Banks	3	1, 4	A	1, 2, 3	LA
P. californica Newport	15	1, 2	A	1, 2, 3	L
Taeniopterygidae					
Taenionema sp.	5	2, 4, 5	A	1	A
Nemouridae	190	2, 4, 5	A	1, 3	LA
Soyedina spp.	1	4	A	1	A
Visoka sp.	1	2	A	3	L
Nemoura spp.	193	1, 2, 4, 5	A	1	LA
N. (Nemoura) sp.	11	2, 4, 5	A	1	LA
Zapada spp.	153	1, 2, 4, 5	A	1, 2	LA
Zapada cinctipes Banks	1,053	1, 2, 4, 5	A	1, 2, 3	LA
Malenka spp.	3	5	A	1, 3	L
Podmosta spp.	1,168	1, 2, 4, 5	A	1, 2, 3	LA
Amphinemoura sp.	2	5	A	1, 2	L
Leuctridae	7	1, 4, 5	A	1, 2	LA
Leuctra sp.	1	4	A	1	A
Despaxia augusta Banks	5	1	A	1, 3	L
Paraleuctra spp.	25	1, 2, 5	A	1, 2, 3	LA
Megaleuctra sp.	1	5	A	1	A
Capniidae	528	1, 2, 4, 5	A	1, 2, 3	LA
Eucapnopsis sp.	73	2, 4, 5	A	1	LA
Capnia sp.	1	4	A	1	A
Capnia spp.(complex)	322	1, 2	A	1, 3	L
Utacapnia sp.	1	4	A	1	A
Perlidae	3,752	1, 2, 5	A	1, 2, 3	LA
Acroneuria spp.	6	4, 5	A	1, 3	L
Calineuria californica (Banks)	3,902	1, 2, 5	A	1, 2, 3	L
Perlodidae	178	1, 2, 4, 5	A	1, 2, 3	LA
Isoperla spp.	56	1, 2, 3, 4, 5	A	1, 2, 3	LA

Table 1—Invertebrates collected from Meadow Creek, Union County, Oregon, 1976-80 (continued)

Taxon	Number	Sample type[1]	Habitat type[2]	Season[3]	Life stage[4]
I. fusca (Needham and Claassen)	1	1	A	1	L
I. marmorata (Needham and Claassen)	1	4	A	1	A
Perlinodes aurea Smith	583	1, 2, 4, 5	A	1, 2, 3	LA
Skwala spp.	329	1, 2, 4	A	1, 2, 3	LA
Cultus sp.	2	2	A	3	L
Chloroperlidae	2,760	1, 2, 3, 4, 5	A	1, 2	LA
Sweltsa spp.	108	1, 2, 4, 5	A	1, 2	LA
S. coloradensis Banks	2	2	A	1	A
Psocoptera	67	2, 4, 5	T	1, 2, 3	LA
Mallophaga	1	4	T	1	A
Thysanoptera	72	1, 2, 4, 5	T	1, 2, 3	LA
Hemiptera	162	1, 2, 3, 4, 5	A	1, 2, 3	LA
Corixidae	248	1, 2, 3, 4, 5	A	1, 2, 3	LA
Graptocorixa spp.	14	2	A	3	A
Hesperocorixa sp.	2	2	A	1	A
Cydnidae	3	3	T	1	A
Scutelleridae	1	2	T	3	A
Gerridae	47	2, 3	A	1, 2, 3	LA
Gerris spp.	292	1, 2, 3, 4, 5	A	1, 2, 3	LA
Trepobates spp.	14	2, 4, 5	A	2, 3	A
Veliidae	1	4	A	2	A
Rhopalidae	3	2, 5	T	3	A
Saldidae	89	3, 4, 5	T	1, 2, 3	LA
Anthocoridae	3	2	T	2, 3	A
Miridae	26	1, 2, 4, 5	T	1, 2, 3	A
Nabidae	13	1, 2, 4, 5	T	1, 2, 3	A
Reduviidae	1	4	T	2	A
Lygaeidae	49	2, 4, 5	T	1, 2, 3	LA
Berytidae	1	5	T	2	A
Pentatomidae	4	2, 4, 5	T	2, 3	A
Homoptera	453	1, 2, 3, 4, 5	T	1, 2, 3	LPA
Membracidae	1	4	T	3	A
Cicadellidae	3,843	1, 2, 3, 4, 5	T	1, 2, 3	LA
Cercopidae	53	1, 2, 3, 4, 5	T	1, 2, 3	LA
Delphacidae	29	1, 2, 4, 5	T	1, 2, 3	LA
Psyllidae	81	1, 2, 3, 4, 5	T	1, 2, 3	LA
Aphididae	728	1, 2, 3, 4, 5	T	1, 2, 3	LA
Adelgidae	111	2, 4, 5	T	2, 3	LA
Eriosomatidae	6	4, 5	T	3	A
Coleoptera	197	1, 2, 3, 4, 5	A	1, 2, 3	LA
Lathridiidae	1	2	T	3	A
Carabidae	102	1, 2, 3, 4, 5	T	1, 2, 3	A
Haliplidae	8	1, 2, 3, 5	A	1, 2, 3	LA
Haliplus spp.	18	2, 4	A	2, 3	LA
Brychius spp.	78	1, 2, 5	A	1, 2, 3	LA
Polyphaga spp.	8	5	A	2	LA
Amphizoidae	12	1, 2	A	1, 2, 3	LA
Dytiscidae	26	1, 2, 3, 4, 5	A	1, 2, 3	LA
Deronectes sp.	2	1, 2	A	1, 3	A
Oreodytes spp.	5	2, 5	A	1, 2, 3	A
Bidessus spp.	12	2	A	3	A
Hydroporus spp.	13	2, 5	A	1, 2, 3	A
Dermestidae	2	1, 2	A	2, 3	A
Histeridae	2	5	A	3	A
Hydrophilidae	20	2, 4, 5	A	1, 2, 3	LA
Hydrochus sp.	1	4	A	2	A
Paracymus spp.	24	1, 2, 5	A	1, 2, 3	LA
Anacaena sp.	2	2	A	1, 3	A
Chaetarthria sp.	1	1	A	1	A
Laccobius sp.	1	2	A	3	A
Sphaeridium sp.	1	2	A	1	A
Berosus sp.	1	2	A	3	A

Table 1—Invertebrates collected from Meadow Creek, Union County, Oregon, 1976-80 (continued)

Taxon	Number	Sample type[1]	Habitat type[2]	Season[3]	Life stage[4]
Helophorus spp.	6	2, 3, 5	A	1, 2, 3	A
Hydrobius sp.	1	5	A	1	A
Hydraenidae					
Hydraena spp.	95	2, 4	A	1, 2, 3	A
Ochthebius sp.	10	2	A	1, 3	A
Scarabaeidae	19	2, 4, 5	T	1, 3	A
Ptiliidae	13	2, 4, 5	T	1, 2, 3	A
Chrysomelidae	98	1, 2, 4, 5	A	1, 2, 3	A
Staphylinidae	661	1, 2, 3, 4, 5	A	1, 2, 3	LA
Scydmaenidae	3	4, 5	T	3	A
Cantharidae	48	1, 2, 4, 5	T	1, 2, 3	LA
Curculionidae	28	1, 2, 4, 5	T	1, 2, 3	A
Scolytidae	37	2, 4, 5	T	1, 2, 3	A
Elateridae	13	2, 3, 5	T	1, 2, 3	A
Byrrhidae	12	4, 5	T	1, 2, 3	A
Buprestidae	1	4	T	2	A
Psephenidae	6	1, 2	A	1, 2	L
Elmidae	110	1, 2, 3, 4, 5	A	1, 2, 3	LA
Heterlimnius spp.	42	1, 2, 4, 5	A	2, 3	LA
H. koebelei Martin	208	1, 2, 5	A	1, 2	A
Optioservus spp.	2,436	1, 2, 4, 5	A	1, 2, 3	LA
O. divergens (Le Conte)	3	1	A	1, 3	A
Narpus spp.	21	1	A	1, 2, 3	L
N. angustus Casey	6	1, 2	A	1, 2, 3	A
Zaitzevia spp.	638	1, 2	A	1, 2, 3	L
Z. parvula (Horn)	326	1, 2, 4, 5	A	1, 2, 3	A
Microcylloepus pusillus Le Conte	7	1	A	2, 3	LA
Cleptelmis spp.	53	1, 2, 5	A	1, 2, 3	LA
C. ornata (Schaeffer)	47	1, 2, 5	A	1, 2, 3	A
C. addenda (Fall)	1	1	A	3	A
Ordobrevia sp.	450	1, 2, 5	A	1, 2, 3	LA
O. nubifera (Fall)	83	1, 2	A	1, 2, 3	LA
Derodontidae	1	U	T	U	A
Cryptophagidae	1	2	T	1	A
Rhizophagidae	3	5	T	1, 3	A
Nitidulidae	5	2, 4, 5	T	1, 2, 3	A
Cucujidae	1	4	T	2	A
Coccinellidae	9	2, 3, 4, 5	T	1, 2, 3	A
Cerambycidae	6	4, 5	T	1, 2	A
Anthicidae	1	4	T	2	A
Mecoptera	1	4	T	3	A
Neuroptera	29	2, 5	T	1, 2, 3	LA
Sialidae					
Sialis spp.	21	1, 5	A	1, 3	L
Raphidiidae	6	2, 3, 4, 5	T	1	A
Hemerobiidae	3	2, 4	T	2, 3	A
Trichoptera	1,213	1, 2, 3, 4, 5	A	1, 2, 3	LPA
Limnephilidae	153	1, 2, 4, 5	A	1, 2, 3	LPA
Neophylax spp.	321	1, 2, 4, 5	A	1, 2, 3	L
Apatania spp.	5	1	A	1	L
Dicosmoecus spp.	56	1, 2, 5	A	1, 2, 3	LP
Ecclisomyia spp.	3	5	A	1, 2	L
Onocosmoecus spp.	6	1, 2	A	1, 3	L
Psychoglypha spp.	4	1, 2	A	2, 3	L
Limnephilus sp.	1	4	A	1	L
Philopotamidae	260	1, 2, 4, 5	A	1, 3	LPA
Wormaldia spp.	34	1, 2, 5	A	1, 2, 3	L
Dolophilodes spp.	3	1	A	3	L
Rhyacophilidae	9	1, 2, 4, 5	A	2, 3	LPA
Rhyacophila spp.	9	1, 2, 5	A	2, 3	LP
R. (nevadensis) group	4	5	A	1	L
R. (rotunda) group	9	1, 2	A	1, 2, 3	L
R. (sibirica) group	2	5	A	1, 3	L

Table 1—Invertebrates collected from Meadow Creek, Union County, Oregon, 1976-80 (continued)

Taxon	Number	Sample type[1]	Habitat type[2]	Season[3]	Life stage[4]
R. (coloradensis) group	7	1	A	1, 3	L
Hydropsychidae	139	1, 2, 4, 5	A	1, 2, 3	LA
Hydropsyche spp.	7,167	1, 2, 4, 5	A	1, 2, 3	LA
Psychomyiidae	3	2, 5	A	2, 3	LA
Psychomyia spp.	8	1, 5	A	3	L
Brachycentridae					
Amiocentrus spp.	9	2, 5	A	1	L
Micrasema spp.	5	1, 2, 5	A	1, 2, 3	L
Brachycentrus sp.	1	1	A	U	L
Lepidostomatidae					
Lepidostoma spp.	31,765	1, 2, 4, 5	A	1, 2, 3	LPA
Glossosomatidae	163	1, 2, 4, 5	A	1, 2, 3	LPA
Agapetus sp.	1	5	A	3	A
Glossosoma spp.	525	1, 2, 4, 5	A	1, 2, 3	LPA
Phryganeidae	1	4	A	3	A
Hydroptilidae	396	1, 2, 4, 5	A	1, 2, 3	LPA
Hydroptila spp.	40	1, 2, 5	A	1, 2, 3	L
Leucotrichia spp.	5	1, 2, 5	A	2, 3	L
Ochrotrichia spp.	87	1, 2, 5	A	1, 2, 3	L
Alisotrichia spp.	16	1, 2, 5	A	2, 3	L
Neotrichia spp.	9	1, 5	A	2	L
Stactobiella sp.	11	1, 2	A	1	L
Sericostomatidae					
Gumaga sp.	2	4	A	2	A
Helicopsychidae	8	1, 4, 5	A	2, 3	LPA
Helicopsyche spp.	40	1, 2, 5	A	1, 2, 3	L
Lepidoptera	466	1, 2, 3, 4, 5	A	1, 2, 3	LPA
Noctuidae	6	4	A	2	LA
Geometridae	16	2, 4	T	2, 3	LA
Pyralidae	779	1, 2, 4, 5	A	1, 2, 3	LPA
Diptera	47	1, 2, 4, 5	A	1, 2, 3	LPA
Nematocera	3	2, 5	A	2, 3	LA
Tipulidae	4,936	1, 2, 3, 4, 5	A	1, 2, 3	LPA
Antocha spp.	2,428	1, 2, 4, 5	A	1, 2, 3	LPA
Limnophila spp.	3,059	1, 2, 5	A	1, 2, 3	L
Dicranota spp.	77	1, 2, 4, 5	A	1, 2, 3	L
Tipula spp.	5	2, 5	A	3	L
Hexatoma spp.	1,305	1, 2, 5	A	1, 2, 3	L
Rhabdomastix spp.	5	1	A	1	L
R. fescigera Alexander	1	1	A	1	L
Gonomyia spp.	5	1	A	1	L
Psychodidae	183	1, 2, 3, 4, 5	A	1, 2, 3	LPA
Pericoma spp.	29	1, 2	A	1, 2, 3	L
Maruina sp.	1	5	A	1	L
Ptychopteridae (= Liriopeidae)	1	2	A	2	L
Blephariceridae	14	1, 2, 3, 4, 5	A	1	LPA
Deuterophlebiidae	58	1, 2, 3, 4, 5	A	1, 2, 3	LPA
Dixidae	42	2, 3, 4, 5	A	1, 2, 3	LPA
Dixa sp.	120	1, 2, 4, 5	A	2, 3	LP
Meringodixa sp.	6	2	A	3	L
Paradixa sp.	6	2	A	U	L
Culicidae	27	2, 4, 5	A	1, 2	PA
Ceratopogonidae (= Heleidae)	321	1, 2, 3, 4, 5	A	1, 2, 3	LPA
Atrichopogon sp.	1	5	A	3	L
Bezzia spp.	1,090	1, 2, 5	A	1, 2, 3	L
Chironomidae					
(= Tendipedidae)	32,484	1, 2, 3, 4, 5	A	1, 2, 3	LPA
Chironomini, tribe	4,326	1, 2, 4, 5	A	1, 2, 3	LP
Tanytarsini, tribe	10,360	1, 2, 4, 5	A	1, 2, 3	LPA
Pentaneurini, tribe	1,809	1, 2, 4, 5	A	1, 2, 3	LP
Macropelopiini, tribe	4	1	A	1, 3	L
Diamesini, tribe	97	1, 2, 5	A	1, 2, 3	LP
Orthocladiini, tribe	9,905	1, 2, 4, 5	A	1, 2, 3	LPA
Corynoneurini, tribe	605	1, 2, 4, 5	A	1, 2, 3	LP

Table 1—Invertebrates collected from Meadow Creek, Union County, Oregon, 1976-80 (continued)

Taxon	Number	Sample type[1]	Habitat type[2]	Season[3]	Life stage[4]
Simuliidae	506	1, 2, 3, 4, 5	A	1, 2, 3	LPA
Prosimulium spp.	215	1, 2, 5	A	1, 2, 3	LP
Simulium spp.	375	1, 2, 4, 5	A	1, 2, 3	L
Twinnia sp.	5	2	A	1	L
Bibionidae	76	2, 3, 4, 5	T	1, 2, 3	LA
Mycetophilidae	336	1, 2, 3, 4, 5	T	1, 2, 3	A
Sciaridae	1,375	1, 2, 3, 4, 5	T	1, 2, 3	LA
Scatopsidae	1	4	T	2	A
Cecidomyiidae	185	1, 2, 3, 4, 5	T	1, 2, 3	LA
Brachycera	174	2, 4, 5	A	1, 2, 3	LA
Acroceridae	2	4	T	1	A
Coenomyiidae	1	5	T	1	A
Stratiomyidae	5	1, 2, 5	A	1, 3	L
Tabanidae	118	1, 2, 5	A	1, 2, 3	L
Rhagionidae	96	1, 2, 3, 4, 5	T	1, 2, 3	LA
Atherix spp.	159	1	A	1, 2, 3	L
Asilidae	90	2, 3, 4, 5	T	1, 2, 3	A
Bombyliidae	5	4	T	1, 2	A
Empididae	1,705	1, 2, 3, 4, 5	T	1, 2, 3	LPA
Dolichopodidae	5,710	1, 2, 3, 4, 5	T	1, 2, 3	A
Cyclorrhapha	2,773	1, 2, 3, 4, 5	T	1, 2, 3	LPA
Lonchopteridae	6	1, 2, 4	T	2, 3	A
Phoridae	152	2, 3, 4, 5	T	1, 2, 3	LA
Pipunculidae	7	2, 4, 5	T	2	A
Syrphidae	19	2, 3, 4, 5	T	1, 2, 3	LA
Sepsidae	13	1, 2, 4, 5	T	1, 2, 3	A
Psilidae	10	2, 4, 5	T	1, 2	A
Sphaeroceridae	67	2, 4, 5	T	1, 2, 3	A
Milichiidae	12	1, 2, 4, 5	T	1, 2, 3	A
Ephydridae	2,684	1, 2, 3, 4, 5	A	1, 2, 3	LPA
Drosophilidae	30	1, 2, 4, 5	T	1, 2, 3	A
Chloropidae	28	1, 2, 4, 5	T	1, 2, 3	A
Agromyzidae	24	1, 2, 4, 5	T	1, 2, 3	A
Clusiidae	2	1, 5	T	1, 2	A
Heleomyzidae	38	2, 3, 4, 5	T	1, 2, 3	A
Camillidae	5	2	T	3	A
Sarcophagidae	6	4	T	2	A
Anthomyzidae	2	4, 5	T	1, 2	A
Dryomyzidae	2	4	T	2, 3	A
Platypezidae	2	2	T	3	A
Calliphoridae	9	3, 4	T	1, 2	A
Anthomyiidae	152	1, 2, 3, 4, 5	T	1, 2, 3	A
Muscidae	141	2, 3, 4, 5	A	1, 2, 3	LA
Scatophagidae	2	4, 5	T	2, 3	A
Tachinidae	85	4, 5	T	1, 2, 3	A
Hippoboscidae	1	4	T	3	A
Siphonaptera	2	4	A	2	A
Hymenoptera	141	2, 3, 4, 5	A	1, 2, 3	LA
Symphyta (= Chalastogastra)	19	2, 3, 4, 5	T	1, 2, 3	LA
Tenthredinidae	35	2, 4, 5	T	1, 2, 3	LA
Apocrita (= Clistogastra)					
Ichneumonoidea					
Ichneumonidae	195	1, 2, 3, 4, 5	A	1, 2, 3	A
Braconidae	32	2, 4, 5	A	1, 2, 3	A
Chalcidoidea	350	1, 2, 3, 4, 5	A	1, 2, 3	A
Mymaridae	4	4, 5	A	1, 2	A
Cynipoidea	8	2, 4	T	1, 2	A
Cynipidae	21	2, 5	T	1, 2, 3	A
Proctotrupoidea (= Serphaidea)	215	2, 3, 4, 5	T	1, 2, 3	A
Diapriidae	3	1, 2	A	2	A
Scelionidae	2	4	A	1	A
Bethyloidea					
Dryinidae	1	4	T	2	A
Scolioidea					

Table 1—Invertebrates collected from Meadow Creek, Union County, Oregon, 1976-80 (continued)

Taxon	Number	Sample type[1]	Habitat type[2]	Season[3]	Life stage[4]
Formicidae	1,093	1, 2, 3, 4, 5	T	1, 2, 3	LA
Tiphiidae	1	4	T	2	A
Vespoidea	2	5	T	3	A
Vespidae	4	4	A	2, 3	A
Pompilidae	1	4	T	2	A
Sphecoidea					
Sphecidae	1	5	T	1	A
Apoidea	24	4, 5	T	1, 2, 3	A
Andrenidae	2	4	T	2	A
Halictidae	3	4	T	2	A

[1] Sample type: 1 = benthic; 2 = drift; 3 = sticky trap; 4 = water trap; 5 = stomach; U = unknown.
[2] Habitat type: A = aquatic; T = terrestrial; U = unknown.
[3] Season: 1 = spring; 2 = summer; 3 = fall; U = unknown.
[4] Life stage: L = larva; P = pupa; A = adult.

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GPO 592-955/80082

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From 1976 to 1980, invertebrates were collected three times each year from several reaches of Meadow Creek in eastern Oregon. Five sampling methods were used: benthos, drift, sticky traps, water traps, and fish stomachs. A total of 372 taxa were identified, of which 239 were used as food by rainbow trout (steelhead; *Salmo gairdneri* Richardson). Of the taxa found in trout stomachs, 71 (29.5 percent) were terrestrial.

Keywords: Invertebrates, aquatic life, salmonids.

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March 1988

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